

Physics to the People!

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Many recent studies¹ have documented the decline in scientific interest and understanding among people of all ages in the United States. Though our educational system is the envy of the world in its ability to train scientists, most of the rest of our students and the public as a whole never experience the excitement that we physicists and physics teachers feel about our subject.

The Wonders of Physics

To counter this alarming trend, the University of Wisconsin at Madison began in 1984 a program called "The Wonders of Physics." It was inspired by and patterned after the popular "Chemistry Can Be Fun" presentations of Professor Bassam Shakhashiri and his colleagues at the University of Wisconsin, which follow the tradition of Christmas lectures for children at the Royal Institution in London started by Michael Faraday in the 1840s and continuing to the present. The idea was to select from those lecture demonstrations that we use in our undergraduate general physics courses about 20 to 30 of the most dramatic demonstrations and present them in a fast-paced public presentation suitable for an audience of mixed ages and interests. The primary goal is to entertain and only secondarily to educate, since the program is aimed at those with little interest in or exposure to science. It is a family activity that can be enjoyed on some level by preschoolers as well as by professional physicists.

"The Wonders of Physics" program has been an overwhelming success. In the first seven years it has been put on sixty times to a total audience of about 18,000. A series of six shows are put on

each February for the public, and special shows are done throughout the year for schools and other groups. The shows are put on in the same lecture room that we use for our large undergraduate classes. The room seats 350 people and is always filled to overflowing. We have had to adopt a system of issuing (free) tickets for the public shows to avoid having to turn people away. Having the shows in our physics building allows us to combine the shows with tours of the laboratories, which generates awareness and goodwill among the public upon whose support we ultimately depend. A special, scaled-down traveling version of the show has been developed and taken to schools throughout Wisconsin by some of our graduate students.

It has been our experience that almost any physics teacher with the desire can put on such a program and that it can do much to generate interest in science. The demonstrations need not be elaborate. In fact the simpler demonstrations are usually the best. Most colleges and universities and even the better high schools have more than enough equipment for a modest show. The explanations should be quick and simple—perhaps as we would explain the phenomena to our grandparents. The demonstrations provide the interest and excitement that most of us only dream of generating through our eloquent and passionate speech.

What does help is an uninhibited presenter who is willing to try things that are a bit unusual. A funny costume adds to the atmosphere. Tuxedos can be purchased at surprisingly low prices when formal-wear stores have their periodic clearances. A dramatic entrance and exit

are good. Audience participation is important. Children will always volunteer to assist with the demonstrations. Live music, or even tape-recorded music, and sound effects are good additions. Special guests in the audience or surprise visits by historical figures add a delightful touch. We have invited local politicians, university administrators, and local television personalities. Isaac Newton and Albert Einstein have paid unexpected visits. The most important thing is to have fun and to create a relaxed atmosphere so that the audience enjoys being there and feels part of the presentation.

Demonstrations

We have developed about a hundred demonstrations that have proved especially effective. Many of the demonstrations are the standard ones from classical physics, but some unique demonstrations have been developed for the show. Many of these make their way back into our regular lecture courses. The best demonstrations are those that share the following qualities:

- They are easily visible.
- They yield a dramatic or unexpected result.
- They can be understood at least superficially without extensive explanation.
- They involve some degree of audience participation.

We develop a show that is given about a dozen times in the course of a year. Each year the show is revised, using about a dozen new demonstrations along with about a dozen old favorites. We look for ways to present the old favorites in new and different ways. A year is an adequate time to develop new



demonstrations but not so long that people get out of the habit of attending.

It is helpful to have the demonstrations organized around some theme. We find it useful to divide classical physics into six subject areas: motion, heat, sound, electricity, magnetism, and light, and to group the demonstrations accordingly. We have also done presentations focused on a particular area such as the physics of sound. Others we have done or are planning are physics and magic, randomness and chaos, modern physics, and physics of the weather. The demonstrations need only be loosely tied to the theme.

Videotaping

The effectiveness of the program can be greatly expanded by videotaping the shows. We have established a good relationship with a commercial video producer whom we use regularly. The taping is done with three broadcast-quality cameras and is edited from about an hour and fifteen minutes to just under an hour. Seven tapes have thus far been produced,² and there is a substantial demand for the tapes among schools and cable television stations. Cable stations are especially anxious to obtain good-quality, low-cost, educational programming. One of our local stations shows the tapes about once a week, and the publicity generated helps to sustain interest in the program. We have produced

a brochure advertising the tapes and have distributed it to schools throughout Wisconsin and Minnesota and to cable stations across the nation.

Computer Animations

A useful embellishment has been the use of computer animations to supplement the presentation. Our lecture hall is equipped with a number of television monitors that can display computer graphics. We have cartoons and text scrolling on the monitors before the show. During the show, the computer is used to help explain the phenomena and in some cases as a substitute for the real demonstration. Many of the demonstrations that we do are available³ in the form of computer animations that run on IBM-compatible personal computers. One package, *Physics Demonstrations*, contains five demonstrations on motion and five on sound. A second package, *Chaos Demonstrations*, contains eighteen demonstrations covering chaos, randomness, fractals, cellular automata, and other related topics. These programs serve not only as a lecture aid, but have proved popular among science museums because they can be set to cycle automatically through the demonstrations while still being responsive to keyboard input. We often leave one or both of the programs cycling on a computer outside the lecture room for people to use before and after the show.

Funding

Funding for a public education program as extensive as ours is always a concern. A modest program making use of already existing demonstrations and volunteer help can be started at negligible cost. As the program expands, significant costs arise for publicity, mailing, telephone, printing of handouts and other materials, development of new demonstrations, and videotaping. We recover some costs through donations but have benefited from the University of Wisconsin Office of Outreach Development and a local private foundation (the Brittingham Trust). The National Science Foundation provided funding to assemble a kit of materials containing all the information that someone interested in starting a similar program would find useful.⁴ It includes a how-to book, a list of demonstrations and sources, sample handouts, a sample videotape of "The Wonders of Physics," and the *Physics Demonstrations* software. It is continually updated as we accumulate new ideas.

A Challenge

The involvement in an outreach program of this kind is a highly rewarding experience and one that is strongly recommended to anyone who wants an enjoyable experience while meeting a serious need in our society for generating interest in the wonders of physics!

References

1. See, for example, *The Science Report Card—Elements of Risk and Recovery* (Educational Testing Service, Princeton, NJ).
2. Videotapes of *The Wonders of Physics* are available for rent or purchase from the University of Wisconsin, Bureau of AudioVisual Instruction, P.O. Box 2093, Madison, WI 53701-2093 (800-362-6888).
3. Computer Software, *Physics Demonstrations* and *Chaos Demonstrations* are available from The Academic Software Library, Box 8202, North Carolina State University, Raleigh, NC 27695-8202 (800-955-TASL).
4. *The Wonders of Physics Lecture Kits* are available for \$90 each from The Wonders of Physics, 1150 University Ave., Madison, WI 53706 (608-262-2927).